

WHAT IS CLAIMED IS:

1 1. For use in a single integrated circuit multi-
2 standard demodulator, a frequency domain equalizer for
3 demodulation of a single carrier signal comprising:

4 a signal multiplier producing an equalized output
5 from a frequency domain input and a frequency domain
6 inverse channel estimate; and

7 an adaptive inverse channel estimator calculating
8 said frequency domain inverse channel estimate utilizing a
9 least square cost function.

1 2. The frequency domain equalizer as set forth in
2 Claim 1 wherein said adaptive inverse channel estimator
3 calculates said frequency domain inverse channel estimate
4 utilizing a diagonal correlation matrix.

1 3. The frequency domain equalizer as set forth in
2 Claim 2 wherein said adaptive inverse channel estimator
3 employs a memory, a forgetting factor employed to calculate
4 a current diagonal element within said correlation matrix
5 from a previous diagonal element within said correlation
6 matrix, and an adaptation and error control constant
7 employed to alter a previous inverse channel estimate
8 matrix element to derive a current inverse channel estimate
9 matrix element, wherein values for said forgetting factor
10 and said adaptation and error control constant are selected
11 such that multiplication by either said forgetting factor
12 or said adaptation and error control constant may be
13 implemented by shift and add operations.

1 4. The frequency domain equalizer as set forth in
2 Claim 3 wherein said adaptive inverse channel estimator
3 further comprises:

4 a complex conjugator receiving a delayed input
5 signal;

6 a signal multiplier receiving both said delayed
7 input signal and an output of said complex conjugator;

8 a signal adder receiving an output of said signal
9 multiplier and said previous diagonal element within said
10 correlation matrix multiplied by said forgetting factor, a
11 output of said signal adder comprising said current
12 diagonal element within said correlation matrix.

1 5. The frequency domain equalizer as set forth in
2 Claim 4 wherein said adaptive inverse channel estimator
3 further comprises:

4 a signal divider receiving said output of said
5 complex conjugator and said output of said signal adder;

6 a second signal multiplier receiving an output of
7 said signal divider and a frequency domain error estimate;
8 and

9 a second signal adder receiving an output of said
10 second signal multiplier multiplied by said adaptation and
11 error control constant and said previous inverse channel
12 estimate matrix element, an output of said second signal
13 adder comprising said current inverse channel estimate
14 matrix element.

1 6. A single integrated circuit multi-standard
2 demodulator comprising:

3 a first decoder selectively demodulating a multi-
4 carrier signal; and

5 a second decoder selectively demodulating a
6 single carrier signal, said second decoder including a
7 frequency domain equalizer comprising:

8 a signal multiplier producing an equalized
9 output from a frequency domain input and a frequency
10 domain inverse channel estimate; and

11 an adaptive inverse channel estimator
12 calculating said frequency domain inverse channel
13 estimate utilizing a least square cost function.

1 7. The demodulator as set forth in Claim 6 wherein
2 said adaptive inverse channel estimator calculates said
3 frequency domain inverse channel estimate utilizing a
4 diagonal correlation matrix.

1 8. The demodulator as set forth in Claim 7 wherein
2 said adaptive inverse channel estimator employs a memory, a
3 forgetting factor employed to calculate a current diagonal
4 element within said correlation matrix from a previous
5 diagonal element within said correlation matrix, and an
6 adaptation and error control constant employed to alter a
7 previous inverse channel estimate matrix element to derive
8 a current inverse channel estimate matrix element, wherein
9 values for said forgetting factor and said adaptation and
10 error control constant are selected such that
11 multiplication by either said forgetting factor or said
12 adaptation and error control constant may be implemented by
13 shift and add operations.

1 9. The demodulator as set forth in Claim 8 wherein
2 said adaptive inverse channel estimator further comprises:

3 a complex conjugator receiving a delayed input
4 signal;

5 a signal multiplier receiving both said delayed
6 input signal and an output of said complex conjugator;

7 a signal adder receiving an output of said signal
8 multiplier and said previous diagonal element within said
9 correlation matrix multiplied by said forgetting factor, a
10 output of said signal adder comprising said current
11 diagonal element within said correlation matrix.

1 10. The demodulator as set forth in Claim 9 wherein
2 said adaptive inverse channel estimator further comprises:

3 a signal divider receiving said output of said
4 complex conjugator and said output of said signal adder;

5 a second signal multiplier receiving an output of
6 said signal divider and a frequency domain error estimate;
7 and

8 a second signal adder receiving an output of said
9 second signal multiplier multiplied by said adaptation and
10 error control constant and said previous inverse channel
11 estimate matrix element, an output of said second signal
12 adder comprising said current inverse channel estimate
13 matrix element.

1 11. For use in a frequency domain equalizer, a method
2 of adaptive inverse channel estimation comprising:

3 multiplying a frequency domain input from a
4 single carrier and a frequency domain inverse channel
5 estimate to produce an equalized output; and

6 calculating the frequency domain inverse channel
7 estimate utilizing a least square cost function.

1 12. The method as set forth in Claim 11 wherein the
2 step of calculating the frequency domain inverse channel
3 estimate utilizing a least square cost function further
4 comprises:

5 calculating the frequency domain inverse channel
6 estimate utilizing a diagonal correlation matrix.

1 13. The method as set forth in Claim 12 wherein the
2 step of calculating the frequency domain inverse channel
3 estimate utilizing a least square cost function further
4 comprises:

5 storing a previous diagonal element within the
6 correlation matrix and a previous inverse channel estimate
7 matrix element within a memory;

8 employing a forgetting factor to calculate a
9 current diagonal element within the correlation matrix from
10 the previous diagonal element within the correlation
11 matrix; and

12 employing an adaptation and error control
13 constant to alter the previous inverse channel estimate
14 matrix element and derive a current inverse channel
15 estimate matrix element,

16 wherein values for the forgetting factor and the
17 adaptation and error control constant are selected such
18 that multiplication by either the forgetting factor or the
19 adaptation and error control constant may be implemented by
20 shift and add operations.

1 14. The method as set forth in Claim 13 wherein the
2 step of calculating the frequency domain inverse channel
3 estimate utilizing a least square cost function further
4 comprises:

5 computing a complex conjugate of a delayed input
6 signal;

7 multiplying the delayed input signal with the
8 complex conjugate; and

9 adding a result of multiplying the delayed input
10 signal with the complex conjugate to the previous diagonal
11 element within the correlation matrix multiplied by the
12 forgetting factor to produce the current diagonal element
13 within the correlation matrix.

1 15. The method as set forth in Claim 14 wherein the
2 step of calculating the frequency domain inverse channel
3 estimate utilizing a least square cost function further
4 comprises:

5 dividing the complex conjugate by the current
6 diagonal element within the correlation matrix;

7 multiplying a result of dividing the complex
8 conjugate by the current diagonal element within the
9 correlation matrix with a frequency domain error estimate
10 and the adaptation and error control constant; and

11 adding the previous inverse channel estimate
12 matrix element to a result of multiplying the result of
13 dividing the complex conjugate by the current diagonal
14 element within the correlation matrix with a frequency
15 domain error estimate and the adaptation and error control
16 constant to produce the current inverse channel estimate
17 matrix element.

1 16. A single integrated circuit multi-standard
2 demodulator comprising:

3 an OFDM decoder; and

4 a VSB decoder, said VSB decoder including a
5 frequency domain equalizer comprising:

6 a signal multiplier producing an equalized
7 output from a frequency domain input and a frequency
8 domain inverse channel estimate; and

9 an adaptive inverse channel estimator
10 calculating said frequency domain inverse channel
11 estimate utilizing a least square cost function,
12 wherein said frequency domain equalizer utilizes hardware
13 employed for said OFDM decoder.

1 17. The demodulator as set forth in Claim 16 wherein
2 said adaptive inverse channel estimator calculates said
3 frequency domain inverse channel estimate utilizing:

4 a diagonal correlation matrix;

5 a forgetting factor in calculating a current
6 diagonal element within said correlation matrix from a
7 previous diagonal element within said correlation matrix;

8 an adaptation and error control constant in
9 altering a previous inverse channel estimate matrix element
10 to derive a current inverse channel estimate matrix
11 element,

12 wherein values for said forgetting factor and
13 said adaptation and error control constant are selected
14 such that multiplication by either said forgetting factor
15 or said adaptation and error control constant may be
16 implemented by shift and add operations within said
17 hardware employed for said OFDM decoder.

1 18. The demodulator as set forth in Claim 17 wherein
2 said adaptive inverse channel estimator employs a memory
3 within said hardware employed for said OFDM decoder to
4 store said previous diagonal element for said correlation
5 matrix and said previous inverse channel estimate matrix
6 element.

1 19. The demodulator as set forth in Claim 18 wherein
2 said adaptive inverse channel estimator further comprises:

3 a complex conjugator receiving a delayed input
4 signal;

5 a signal multiplier receiving both said delayed
6 input signal and an output of said complex conjugator;

7 a signal adder receiving an output of said signal
8 multiplier and said previous diagonal element within said
9 correlation matrix multiplied by said forgetting factor, a
10 output of said signal adder comprising said current
11 diagonal element within said correlation matrix.

1 20. The demodulator as set forth in Claim 19 wherein
2 said adaptive inverse channel estimator further comprises:

3 a signal divider receiving said output of said
4 complex conjugator and said output of said signal adder;

5 a second signal multiplier receiving an output of
6 said signal divider and a frequency domain error estimate;
7 and

8 a second signal adder receiving an output of said
9 second signal multiplier multiplied by said adaptation and
10 error control constant and said previous inverse channel
11 estimate matrix element, an output of said second signal
12 adder comprising said current inverse channel estimate
13 matrix element.